

The Gut-Brain **ReSET** for Kids:

MICROBIOME APPROACHES FOR PEDIATRIC MENTAL HEALTH

Elisa Song, MD
Allina Health, November 14, 2025

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Objectives:

1. Review the pathophysiology of leaky gut and endotoxemia, and implications for leaky brain and neuropsychiatric disorders in children
2. Identify the major modern contributors to gut microbiome disruption in children
3. Develop the understanding of how to optimize gut microbiome resilience in children
4. Discuss an integrative, evidence-based approach to healing gut dysregulation, optimizing Vagus Nerve function, and restoring whole child wellness

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WHO I AM

The 2 things I'm most proud of:

- ❖ Mom to 2 thriving kids! ☺
- ❖ Integrative pediatrician in the SF Bay Area



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Who I am



- ❖ Integrative pediatrician and pediatric functional medicine expert with over 20 years of experience
- ❖ Trained at Stanford, NYU School of Medicine, and UCSF Pediatrics Residency
- ❖ Additional training in functional medicine, homeopathy, acupuncture, herbal medicine, and essential oils
- ❖ Teach other practitioners pediatric functional medicine, pediatric acupuncture, and clinical homeopathy (A4M, IFM, CEDH, Academy for Pain Research, Center for Advanced Acupuncture Pediatrics)
- ❖ Created Healthy Kids Happy Kids to be a trusted online holistic pediatric resource for parents and practitioners
- ❖ Author of *Healthy Kids, Happy Kids: An Integrative Pediatrician's Guide to Whole Child Resilience*



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Our “new normal”

Immune Disorders

- ❖ 1 in 5 has eczema
- ❖ 1 in 5 has obesity (1 in 4 among Hispanic and Black children)
- ❖ 1 in 10 has asthma
- ❖ 1 in 13 has anaphylactic food allergies
- ❖ 1 in 13 has autoimmunity

Neurodevelopmental & Neuropsychiatric Concerns

- ❖ 1 in 6 has a developmental disability
- ❖ 1 in 10 has ADHD
- ❖ 1 in 36 has autism
- ❖ By the time kids are 18, 1 in 2 will have a mental health disorder
- ❖ 1 in 3 teens has anxiety
- ❖ 1 in 3 teen girls has seriously thought of suicide (and >1 in 10 have tried)



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Where we are now – The “New Normal”

REFERENCES:

- ❖ <https://www.nimh.nih.gov/health/statistics/any-anxiety-disorder>
- ❖ https://www.cdc.gov/healthyyouth/data/yrbs/yrbs_data_summary_and_trends.htm
- ❖ <https://www.cdc.gov/obesity/data/childhood.html>
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5932324/>
- ❖ <https://publications.aap.org/aapnews/news/13763/Study-1-in-6-children-has-developmental-disability>
- ❖ <https://www.cdc.gov/asthma/nhis/2011/table4-1.htm>
- ❖ <https://www.cdc.gov/ncbddd/adhd/data.html>
- ❖ <https://publications.aap.org/aapnews/news/23904/CDC-Autism-rate-rises-to-1-in-36-children>





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This new normal ...

It's **not** normal!



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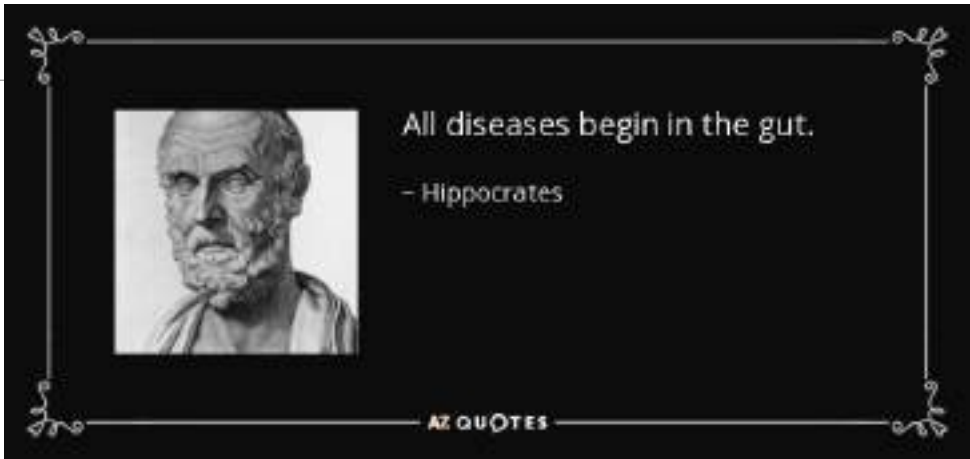
The Root Cause:

OUR KIDS' MICROBIOMES HAVE CHANGED



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All diseases begin in the gut.
- Hippocrates

AZ QUOTES

~400 B.C.

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THE GUT IS NOT LIKE LAS VEGAS -
WHAT HAPPENS IN THE GUT DOES
NOT STAY IN THE GUT.

DR ALESSIO FASANO,
AUTHOR OF "GLUTEN FREEDOM"

WELCOME
TO Fabulous
LAS VEGAS
NEVADA

DrHofFasano.com

Dr. Alessio Fasano, Chief of Pediatric Gastroenterology and Nutrition at Mass General for Children (MGfC)

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All Health Starts in the Gut

The gut-brain connection

❖ Our "second brain"

The gut-immune system connection

The gut-hormone connection

❖ Sex hormones

❖ Thyroid

❖ Adrenals

The gut-metabolism connection

❖ Obesity/overweight

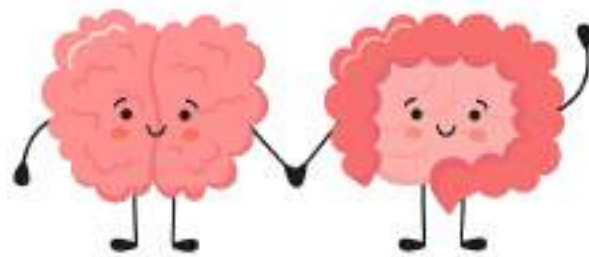
❖ Metabolic syndrome



The Gut-WHOLE BODY Connection

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The Developing Gut-Brain Connection

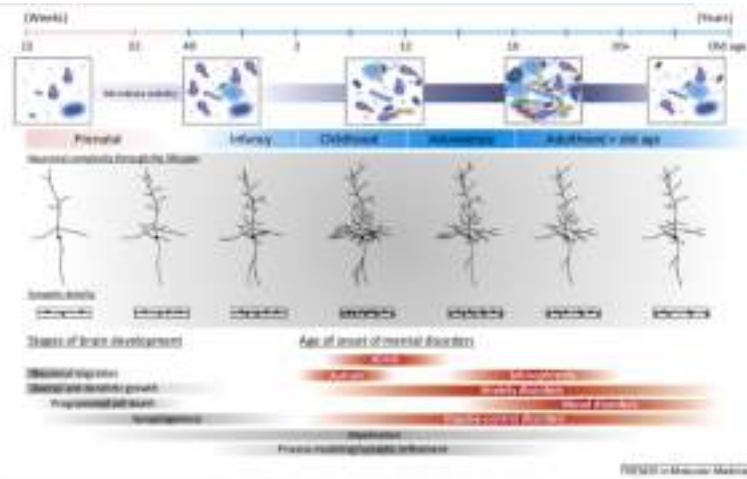


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Your Child's Gut-Brain Connection

- ❖ Development of gut microbiota occurs in **parallel** with neurodevelopment
- ❖ Takes up to 3 years for infant to develop composition and stability of gut microbiota similar to adult
- ❖ First 3 years of life are a critical neurodevelopmental window
- ❖ Critical windows of neurodev in infancy, adolescence, and aging correspond with rapid changes in the gut microbiome
- ❖ **Disruption to developing gut microbiota in first 3 years can impact CNS with adverse effect on behavior and mental health outcomes**



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Borre et al. Microbiota and neurodevelopmental windows: implications for brain disorders. <http://dx.doi.org/10.1016/j.molmed.2014.05.002>

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Early Probiotic Supplementation & Childhood Brain Disorders

- ❖ 75 infants randomized to receive *Lactobacillus rhamnosus* GG (ATCC 53103) or placebo during first 6 months of life and followed for 13 years
- ❖ Gut microbiota assessed at age of 3 weeks, 3,6,12,18, 24 mos, and 13 years
- ❖ RESULTS:
 - ❖ **At age of 13 years, ADHD or Asperger Syndrome (AS) dx'ed in 6/35 (17%) of children in placebo group (3 ADHD, 1 AS, 2 ADHD + AS), and NONE of the 40 in probiotic group (P=0.008)**
 - ❖ **At 3 mos and 6 mos, children later dx'ed with ADHD or AS had significantly lower numbers of *Bifidobacterium longum* than healthy neurotypical kids**
 - ❖ At 18 mos, mean number of *Bacteroides* and *Lactobacillus-Enterococcus* group bacteria lower in kids with ADHD/AS than healthy children
 - ❖ At 24 mos, mean number *Clostridium histolyticum* lower in kids with ADHD/AS
 - ❖ **At age 13, no statistically significant differences in gut microbiota composition between children with or without neuropsychiatric disorders**
 - ❖ Controlled for gender, mode of delivery, gestational age, birthweight, BF, antibiotic treatment first 6 mo of life

Partty A, Kalliomaki M, Wacklin P, Salminen S, Isolauri E. A possible link between early probiotic intervention and the risk of neuropsychiatric disorders later in childhood: a randomized trial. *Pediatric research*. 2015;77(6):823-8. doi:10.1038/pr.2015.51



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Early Probiotic Supplementation & Childhood Brain Disorders

❖ CONCLUSION:

❖ **Probiotic supplementation early in life may reduce the risk of neuropsychiatric disorder development later in childhood possibly by mechanisms not limited to gut microbiota composition**

❖ ** this study originally intended to investigate probiotic supplementation for prevention of atopic eczema

❖ Of note is increased incidence of atopic disease in kids with ADHD

❖ POSTULATION:

❖ Postulated that neural pathways may be altered by the gut microbiome early in development. If such an alteration takes place at a critical moment, the sequential dysfunction of the gut-brain axis may become relatively constant into adulthood



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QUIZ



What connects the gut and the brain?



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The Vagus Nerve: The Gut-Brain Superhighway

- ❖ BI-DIRECTIONAL communication between the gut and the brain via the VAGUS NERVE
 - ❖ Gut microbiome directly influences our emotions, moods and behavior, AND vice versa → 2-way street
- ❖ 80-90% of the communication occurs FROM the gut TO the brain!
- ❖ Enteric glia very similar to CNS astrocytes
 - ❖ Enteric nervous system can live without the brain, but the brain CANNOT live without the enteric nervous system
- ❖ Which really is the "second brain" vs. the "first brain"?



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Gut Microbiome-Neurotransmitter Connection

Neurotransmitters

OUR GUT-BRAIN CHEMICALS

- Serotonin** - Stress Less
- Dopamine** - Get Stuff Done
- Acetylcholine** - Attention and Activation
- GABA** - Get Zen
- Melatonin** - More than Sleep

Elisa Song, MD. *Healthy Kids, Happy Kids*. 2024.

Gut microbes produce hormones and neurotransmitters identical to those produced by humans.

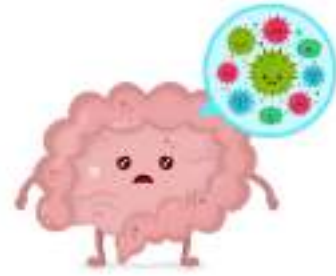
- ❖ *Lactobacillus* species produce acetylcholine and GABA
- ❖ *Bifidobacterium* species produce GABA;
- ❖ *Escherichia* produce norepinephrine, serotonin and dopamine;
- ❖ *Streptococcus* and *Enterococcus* produce serotonin; and
- ❖ *Bacillus* species produce norepinephrine and dopamine
- ❖ 90% of our serotonin is made by our gut microbiota
- ❖ 50% of our dopamine is made by our gut microbiota
- ❖ Our gut microbiome produces 400X melatonin than our pineal gland

Galland Leo. The Gut Microbiome and the Brain. *Journal of Medicinal Food*. 2014;17(12):1261-1272. doi:10.1089/jmf.2014.7000.



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What happens when the gut microbiome becomes disrupted?

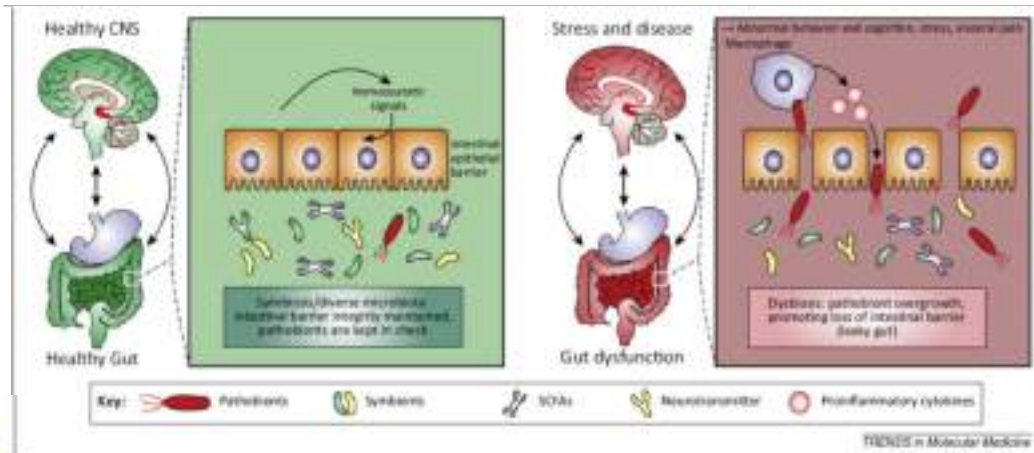
IMPLICATIONS FOR CHILDREN'S MENTAL HEALTH



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Microbiota-Gut-Brain Axis In Health & Disease



Borre YE, O'Keefe GW, Clarke G, Stanton C, Dinan TG, Cryan JF. Microbiota and neurodevelopmental windows: implications for brain disorders. Trends Mol Med. 2014;20(9):509-518. doi:10.1016/j.molmed.2014.05.002



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Microbiome disruption & children's mental health

Antibiotic use during the first 2 years of life may increase the risk of mental health concerns later in childhood or adolescence by **up to 50%** - including sleep disorders, ADHD, mood and anxiety disorders, and other behavioral concerns

Study population: All births in Finland between 1996 and 2012, 1 million births, studied for **antibiotic drug exposure: mothers during pregnancy and the children the first two postnatal years.**

- ❖ RESULT: 10–50% increased risks of childhood-onset sleep disorders, ADHD, conduct disorder, mood and anxiety disorders, and other behavioral and emotional disorders
 - ❖ Strongest risk for antibiotic exposure **BEFORE 6 months** of age
 - ❖ The more rounds of antibiotics, the higher the risk
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6879739/>



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Antibiotics & Anxiety

- ❖ Treatment with a single antibiotic course associated with higher risk for depression and anxiety with **all** antibiotic groups tested
 - ❖ Penicillins, quinolones, sulfonamides
- ❖ Increased risk with recurrent antibiotic exposures
 - ❖ Lurie I et al. Antibiotic exposure and the risk for depression, anxiety, or psychosis: a nested case-control study. [J Clin Psychiatry](#). 2015 Nov;76(11):1522-8. doi: 10.4088/JCP.15m09961.



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Antibiotics & the Gut Microbiome



Antibiotics are the single biggest ACUTE disruptor to the gut microbiome

1. Use antibiotics judiciously and appropriately – make sure they're really “necessary”
2. Work with patients restore their microbiome resilience after antibiotics and other microbiome-disrupting meds



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“Psychobiotic” supplementation reduces anxiety & depression

- ❖ Lactobacillus plantarum strain PS128 increases dopamine and serotonin
 - ❖ New research around AUTISM → daily administration improves 2 core sx of autism
 - ❖ Persistent deficits in social communication and social interaction
 - ❖ Restricted, repetitive patterns of behavior or activities
- ❖ Lactobacillus helveticus Rosell-52 ME and Bifidobacterium longum Rosell-175 ME reduces anxiety and depression
- ❖ Lactobacillus casei strain Shirota prevents physical sx under stress
- ❖ Lactobacillus helveticus NS8 works better than citalopram in reducing stress-induced anxiety, depression, and cognitive dysfunction; lowers cortisol and restores serotonin to normal.

Mital et al. 2016. Neurotransmitters: The critical modulators regulating the gut-brain-axis. [J Cell Physiol](#). Aug 11. doi: 10.1002/jcp.25518.



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“Psychobiotic” supplementation reduces anxiety & depression

- ❖ Lactobacillus helveticus R0052 and Bifidobacterium longum R0175 reduced psychological distress
 - ❖ Assessed through the Hopkins Symptoms Checklist, Hospital Anxiety and depression Scale, Perceived Stress Scale, Coping Checklist, and 24 hr urinary free cortisol
 - ❖ Messasoudi et al. Assessment of psychotropic-like properties of a probiotic formulation (Lactobacillus helveticus R0052 and Bifidobacterium longum R0175) in rats and human subjects. [Br J Nutr.](#) 2011 Mar;105(5):755-64. doi: 10.1017/S0007114510004319.
- ❖ 2 meta-analyses of 17 randomized controlled human trials show psychological benefit from probiotic supplementation
 - ❖ Pirbaglou M et al. Probiotic supplementation can positively affect anxiety and depressive symptoms: a systematic review of randomized controlled trials. [Nutr Res.](#) 2016 Sep;36(9):889-898. doi: 10.1016/j.nutres.2016.06.009.
 - ❖ McKean J et al. Probiotics and Subclinical Psychological Symptoms in Healthy Participants: A Systematic Review and Meta-Analysis. [J Altern Complement Med.](#) 2017 Apr;23(4):249-258. doi: 10.1089/acm.2016.0023.



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Fermented Foods Can Reduce Social Anxiety

- ❖ Study of 710 young adults (445 females)
- ❖ Looked at association between eating fermented foods, neuroticism and social anxiety
- ❖ “Neurotic” patients who consumed fermented foods more frequently had less social anxiety.
- ❖ CONCLUSION: Fermented foods that contain probiotics may have a protective effect against social anxiety symptoms for those at higher genetic risk, as indexed by trait neuroticism.

Consumption of fermented foods that contain probiotics may serve as a low-risk intervention for reducing social anxiety.

Wahlire MR et al. Fermented foods, neuroticism, and social anxiety: An interaction model. [Psychiatry Res.](#) 2015 Aug 15;228(2):203-8. doi: 10.1016/j.psychres.2015.04.023.



NOTE: Benefit of fermented foods may be due to POSTBIOTICS (neurotransmitters, butyrate, etc.)



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What's Going on?

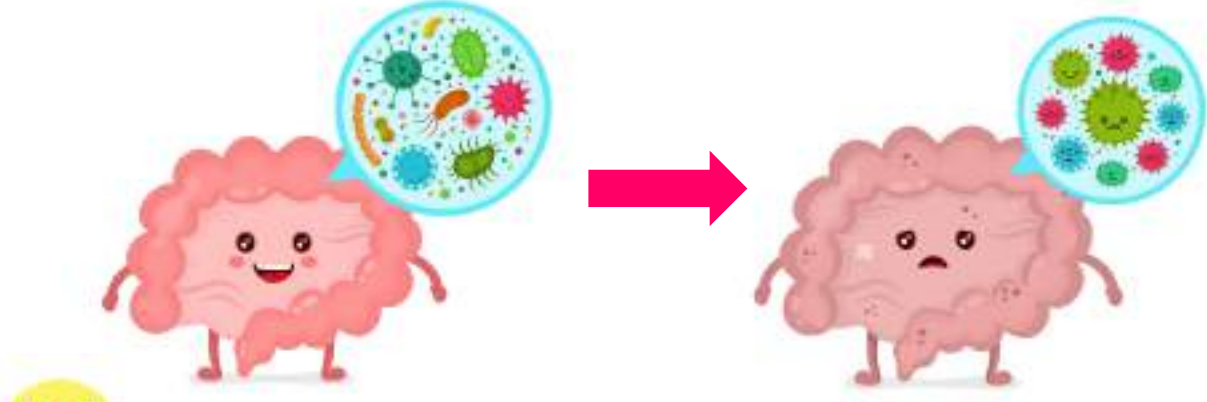
GUT-BRAIN DYSFUNCTION IN OUR KIDS




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When the Gut Microbiome is Disrupted → Gut Dysbiosis, Leaky Gut, Metabolic Endotoxemia



The diagram illustrates the transition from a healthy state to a disrupted state. On the left, a pink, fluffy cartoon character representing the gut has a happy expression and a speech bubble containing a diverse and colorful array of various microorganisms. A large red arrow points to the right, where the same pink character has a sad expression and a speech bubble containing a less diverse microbiome with fewer types of organisms. This visualizes the concept of gut dysbiosis.



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When the gut microbiome is disrupted ...

HEALTHY GUT
Good stuff gets in.
Bad stuff stays out.
Immune system stays calm.

VS.

LEAKY GUT
Bad stuff gets in.
Good stuff stays out.
Immune system is unhappy.

Nutrients

Probiotics

Blood Cells

Pathogens/
Infections

Toxins

Drugs

Inflammatory
Food

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Leaky Gut & ADHD

- ❖ Higher Zonulin and Occludin found in children with ADHD
 - ❖ Zonulin = marker of leaky gut (and leaky brain, heart, lungs, liver, kidneys, skin, immune cells, adipose tissue)
- ❖ The higher the zonulin, the more the hyperactivity and social impairment

- ❖ Lee SY, Li SC, Yang CY, Kuo HC, Chou WJ, Wang LJ. Gut Leakage Markers and Cognitive Functions in Patients with Attention-Deficit/Hyperactivity Disorder. *Children (Basel)*. 2023;10(3):513. Published 2023 Mar 5. doi:10.3390/children10030513
- ❖ Aydoğan Avşar P, Işık Ü, Aktepe E, Kılıç F, Doğuç DK, Büyükbayram Hİ. Serum zonulin and claudin-5 levels in children with attention-deficit/hyperactivity disorder. *Int J Psychiatry Clin Pract*. 2021;25(1):49-55. doi:10.1080/13651501.2020.1801754
- ❖ Özyurt G, Öztürk Y, Appak YÇ, et al. Increased zonulin is associated with hyperactivity and social dysfunctions in children with attention deficit hyperactivity disorder. *Compr Psychiatry*. 2018;87:138-142. doi:10.1016/j.comppsy.2018.10.006

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Leaky Gut & OCD

- ❖ Higher serum Claudin-5 found in children with OCD
 - ❖ Transmembrane tight junction protein
- ❖ Serum zonulin levels not significantly different

❖ Asbjornsdottir B, Snorraddottir H, Andresdottir E, et al. Zonulin-Dependent Intestinal Permeability in Children Diagnosed with Mental Disorders: A Systematic Review and Meta-Analysis. *Nutrients*. 2020;12(7):1982. Published 2020 Jul 3. doi:10.3390/nu12071982



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Leaky Gut & MIS-C

- ❖ Increased Zonulin found in children with MIS-C
- ❖ Larazotide, an experimental medicine for Leaky Gut resulted in:
 - ❖ Decreased plasma SARS-CoV-2 spike antigen levels
 - ❖ Decreased inflammatory markers
 - ❖ IMPROVED clinical outcomes

❖ Kiliç AO, Akin F, Yazar A, Metin Akcan Ö, Topcu C, Aydın O. Zonulin and claudin-5 levels in multisystem inflammatory syndrome and SARS-CoV-2 infection in children [published correction appears in *J Paediatr Child Health*. 2023 Aug;59(8):1010]. *J Paediatr Child Health*. 2022;58(9):1561-1565. doi:10.1111/jpc.16033

❖ Hensley-McBain T, Manuzak JA. Zonulin as a biomarker and potential therapeutic target in multisystem inflammatory syndrome in children. *J Clin Invest*. 2021;131(14):e151467. doi:10.1172/JCI151467

❖ Yonker LM, Gilboa T, Ogata AF, et al. Multisystem inflammatory syndrome in children is driven by zonulin-dependent loss of gut mucosal barrier. *J Clin Invest*. 2021;131(14):e149633. doi:10.1172/JCI149633



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The Perfect Storm:

Gut Dysbiosis + Leaky Gut → Metabolic Endotoxemia

LPS-induced metabolic endotoxemia

- ❖ LPS is an endotoxin derived from the outer membrane of **gram-negative bacteria**.
- ❖ Circulating LPS binds to LBP and LPS-LBP complexes → activate NKFB and increase inflammatory cytokines **wherever they end up** – brain, gut, joints, etc.
- ❖ Metabolic endotoxemia occurs when serum endotoxins (LPS) are absorbed through a **permeable gut lining** (AKA "leaky gut")
- ❖ Metabolic endotoxemia associated with increased risk for anxiety, depression, cognitive decline, autoimmunity, diabetes, obesity, cardiovascular disease, ARDS, sepsis, cytokine storm, and COVID-19
 - ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3294426/>
 - ❖ <https://www.karger.com/Article/Abstract/315914>

Endotoxin-producing Gram-negative Bacteria (**Enterobacteriaceae**)

- ❖ Escherichia coli, Salmonella, Shigella, Pseudomonas, Klebsiella, Citrobacter, Enterobacter, Proteus, Serratia

Gram-positive bacteria produce exotoxins, not endotoxins

Microorganisms that produce endotoxin-like compounds

- ❖ Streptococcus, Listeria monocytogenes, Candida



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Endotoxin-producing microorganisms

Gram-negative Enterobacteriaceae

- ❖ Escherichia coli
- ❖ Salmonella
- ❖ Shigella
- ❖ Pseudomonas
- ❖ Klebsiella
- ❖ Citrobacter
- ❖ Enterobacter
- ❖ Proteus
- ❖ Serratia
- ...

Endotoxin-like compounds also produced by Streptococcus, Listeria & Candida



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Metabolic Endotoxemia in Pediatric Neuropsychiatric Conditions

❖ Children with PANS/PANDAS

❖ Loffredo L, Spalice A, Salvatori F, et al. Oxidative stress and gut-derived lipopolysaccharides in children affected by paediatric autoimmune neuropsychiatric disorders associated with streptococcal infections. *BMC Pediatr.* 2020;20(1):127. Published 2020 Mar 18. doi:10.1186/s12887-020-02026-8

❖ Children with autism and ADHD

❖ Bundgaard-Nielsen C, Lauritsen MB, Knudsen JK, et al. Children and adolescents with attention deficit hyperactivity disorder and autism spectrum disorder share distinct microbiota compositions. *Gut Microbes.* 2023;15(1):2211923. doi:10.1080/19490976.2023.2211923

❖ Children with mental disorders

❖ Asbjornsdottir B, Snorraddottir H, Andresdottir E, et al. Zonulin-Dependent Intestinal Permeability in Children Diagnosed with Mental Disorders: A Systematic Review and Meta-Analysis. *Nutrients.* 2020;12(7):1982. Published 2020 Jul 3. doi:10.3390/nu12071982



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Endotoxemia, Probiotics & Anxiety During Puberty

❖ Study: A single exposure to LPS during puberty → enduring depression in females and anxiety in males into adulthood (in mice)

❖ Probiotics given to mice during puberty after exposure to LPS :

- ❖ Reduced LPS-induced sickness behavior
- ❖ Prevented LPS-induced increases in pro-inflammatory cytokines
- ❖ Prevented LPS-induced changes to gut microbiota
- ❖ Reduced cytokine production in the BRAIN
 - ❖ Hypothalamus, hippocampus, and PFC)
- ❖ Prevented enduring LPS-induced anxiety and depression into adulthood

❖ CONCLUSION: Probiotic supplementation during puberty mitigates inflammation and decreases stress-induced vulnerabilities to emotional behaviours later in life

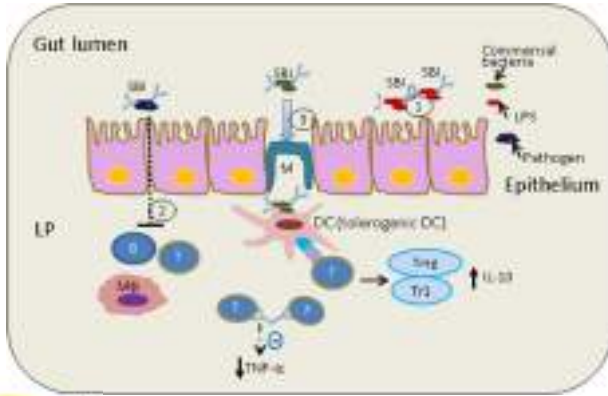
❖ Murray E et al. Probiotic consumption during puberty mitigates LPS-induced immune responses and protects against stress-induced depression- and anxiety-like behaviors in adulthood in a sex-specific manner. *Brain Behav Immun.* 2019 Jun 15. pii: S0889-1591(19)30338-1. doi: 10.1016/j.bbi.2019.06.016.



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Reducing Endotoxemia: Serum-derived Immunoglobulin (SBI)



- (1) SBI binds luminal bacteria and their endotoxins (LPS) to prevent circulating LPS
- (2) Reduced transepithelial antigen absorption across the small and/or large intestine has been linked to reduced immune activation
- (3) SBI may interact with healthy commensals to induce tolerogenic DCs.

Oral SBI found to decrease **systemic** inflammation and leaky gut in people with HIV
 → significantly decreased IL-6 and Zonulin

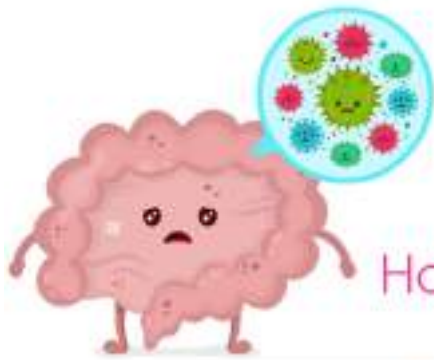
- Utay NS, Somasunderam A, Hinkle JE, et al. Serum Bovine Immunoglobulins Improve Inflammation and Gut Barrier Function in Persons with HIV and Enteropathy on Suppressive ART. *Pathog Immun.* 2019;4(1):124-146. Published 2019 May 3. doi:10.20411/pai.v4i1.276

FIGURE 1 Proposed mechanisms of action of oral Ig SBI...
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How does the gut microbiome become disrupted?

MICROBIOME MISCHIEF MAKERS




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Modern Microbiome Mischief Makers

<p>Medications</p> <ul style="list-style-type: none"> ❖ Antibiotics ❖ NSAIDs (like ibuprofen) ❖ Reflux/antacid medications ❖ Antihistamines (Zyrtec, Claritin) ❖ Steroids ❖ Oral contraceptives ❖ SSRIs <p>Environment</p> <p>Glyphosate</p>	<p>Ultraprocessed foods</p> <ul style="list-style-type: none"> ❖ Too many preservatives (e.g., MSG, BHA, BHT, etc.) ❖ Too many sweeteners (e.g., high fructose corn syrup, etc.) ❖ Too many food additives (e.g., emulsifiers) <p>Electromagnetic Frequencies (EMF's)/Screens</p> <p>Screening time</p> <p>Psychological stress</p> <p>Lifestyle stress – lack of exercise, lack of sleep, lack of hydration</p> <p>???</p>
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How many of our kids are exposed to all of these?




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References for Microbiome Mischief Makers

- ❖ <https://www.frontiersin.org/journals/microbiology/articles/10.3389/fmicb.2020.578007/full>
- ❖ <https://pubmed.ncbi.nlm.nih.gov/29205415/>
- ❖ <https://gut.bmj.com/content/69/8/1510>
- ❖ <https://pubmed.ncbi.nlm.nih.gov/29843725/>
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9029443/>
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7117642/>
- ❖ <https://www.sciencedirect.com/science/article/pii/S0147651321010927>
- ❖ <https://pubmed.ncbi.nlm.nih.gov/30118757/>
- ❖ <https://pubmed.ncbi.nlm.nih.gov/34179053/>
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8800865/>
- ❖ <https://pubmed.ncbi.nlm.nih.gov/34642755/>



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Ultraprocessed Foods & Kids' Brains

- ❖ **Ultra-processed foods** change brain morphology in children with smaller cerebral white matter volume at age 10
 - ❖ Higher quality diet associated with higher IQ, greater brain gyrfication and larger cerebral gray matter volume at age 8
 - ❖ Mou Y, Blok E, Barroso M, Jansen PW, White T, Voortman T. Dietary patterns, brain morphology and cognitive performance in children: Results from a prospective population-based study. *Eur J Epidemiol.* 2023;38(6):669-687. doi:10.1007/s10654-023-01012-5
- ❖ **Ultra-processed foods** associated with ADHD, anxiety, depression, cognitive decline
 - ❖ Prescott SL, D'Adamo CR, Halton KF, Ortiz S, Overby N, Logan AC. Beyond Plants: The Ultra-Processing of Global Diets Is Harming the Health of People, Places, and Planet. *Int J Environ Res Public Health.* 2023;20(15):6461. Published 2023 Jul 27. doi:10.3390/ijerph20156461
- ❖ **Ultra-processed foods** during pregnancy increase risk for ADHD in offspring
 - ❖ Zupo R, Castellana F, Boero G, et al. Processed foods and diet quality in pregnancy may affect child neurodevelopment disorders: a narrative review. *Nutr Neurosci.* Published online April 11, 2023. doi:10.1080/1028415X.2023.2197709
- ❖ It takes only 2 months of a steady diet of processed foods
 - ❖ → to LOWER brain chemicals responsible for learning and memory
 - ❖ Molteni R, Barnard RJ, Ying Z, Roberts CK, Gómez-Pinilla F. A high-fat, refined sugar diet reduces hippocampal brain-derived neurotrophic factor, neuronal plasticity, and learning. *Neuroscience.* 2002;112(4):803-814. doi:10.1016/s0306-4522(02)00123-9
- ❖ 4.5 year-olds who ate a junk food diet
 - ❖ → much more likely to have behavioral problems when they turned 7
 - ❖ Wiles NJ, Northstone K, Emmett P, Lewis G. 'Junk food' diet and childhood behavioural problems: results from the ALSPAC cohort. *Eur J Clin Nutr.* 2009;63(4):491-498. doi:10.1038/sj.ejcn.1602967



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How to Heal the Gut-Brain Connection

TO RESTORE MICROBIOME RESILIENCE
(THE GUT RESET)



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Heal the Gut-Brain Connection

Step 1: Evidence-based symptom relief



Step 2: Optimize Vagal tone(HRV)

Step 3: The Gut ReSET



❖ **R**eturn to the "5 Things" for Microbiome Magic

❖ **S**eal and heal the leaky gut

❖ **E**liminate dysbiotic gut microbiomes (if present)

❖ **T**ransform the gut microbiome

Step 4: Address additional clinical imbalances

❖ Mitochondrial dysfunction, detoxification, chronic infections, mycotoxins, etc.



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EVIDENCE-BASED SYMPTOM RELIEF



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Evidence-Based Symptom Relief: ADHD

- ❖ Saffron 20-30mg/day
 - ❖ Blasco-Fontecilla H, Moyano-Ramírez E, Méndez-González O, Rodrigo-Yanguas M, Martín-Moratinos M, Bella-Fernández M. Effectivity of Saffron Extract (SaffrActiv) on Treatment for Children and Adolescents with Attention Deficit/Hyperactivity Disorder (ADHD): A Clinical Effectivity Study. *Nutrients*. 2022;14(19):4046. Published 2022 Sep 28. doi:10.3390/nu14194046
 - ❖ Baziar S, Aqamolaei A, Khadem E, et al. Crocus sativus L. Versus Methylphenidate in Treatment of Children with Attention-Deficit/Hyperactivity Disorder: A Randomized, Double-Blind Pilot Study. *J Child Adolesc Psychopharmacol*. 2019;29(3):205-212. doi:10.1089/cap.2018.0146
- ❖ Pycnogenol 1mg/kg/day
 - ❖ Blasco-Fontecilla H, Moyano-Ramírez E, Méndez-González O, Rodrigo-Yanguas M, Martín-Moratinos M, Bella-Fernández M. Effectivity of Saffron Extract (SaffrActiv) on Treatment for Children and Adolescents with Attention Deficit/Hyperactivity Disorder (ADHD): A Clinical Effectivity Study. *Nutrients*. 2022;14(19):4046. Published 2022 Sep 28. doi:10.3390/nu14194046
- ❖ PS 300mg, 120mg EPA+DHA), Vitamin B6 (0.6mg/kg/d), Magnesium (6mg/kg/d), Zinc 55mg
 - ❖ Ahn J, Ahn HS, Cheong JH, Dela Peña I. Natural Product-Derived Treatments for Attention-Deficit/Hyperactivity Disorder: Safety, Efficacy, and Therapeutic Potential of Combination Therapy. *Neural Plast*. 2016;2016:1320423. doi:10.1155/2016/1320423
- ❖ L-theanine 400mg/day
 - ❖ Lyon MR, Kapoor MP, Juneja LR. The effects of L-theanine (Suntheanine®) on objective sleep quality in boys with attention deficit hyperactivity disorder (ADHD): a randomized, double-blind, placebo-controlled clinical trial. *Altern Med Rev*. 2011;16(4):348-354.



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Evidence-Based Symptom Relief: OCD

- ❖ N-acetylcysteine (NAC) 900mg TID
 - ❖ Li F, Welling MC, Johnson JA, et al. N-Acetylcysteine for Pediatric Obsessive-Compulsive Disorder: A Small Pilot Study. *J Child Adolesc Psychopharmacol*. 2020;30(1):32-37. doi:10.1089/cap.2019.0041
- ❖ Zinc 440mg/day in adults receiving fluoxetine
 - ❖ Sayyah M, Olapour A, Saeedabad Ys, Yazdan Parast R, Malayeri A. Evaluation of oral zinc sulfate effect on obsessive-compulsive disorder: a randomized placebo-controlled clinical trial. *Nutrition*. 2012;28(9):892-895. doi:10.1016/j.nut.2011.11.027
- ❖ Inositol 18 grams/day in adults
 - ❖ Fux M, Levine J, Aviv A, Belmaker RH. Inositol treatment of obsessive-compulsive disorder. *Am J Psychiatry*. 1996;153(9):1219-1221. doi:10.1176/ajp.153.9.1219
- ❖ Milk Thistle 600mg/day in adults
 - ❖ Sayyah M, Boostani H, Paksereshf S, Malayeri A. Comparison of Silybum marianum (L.) Gaertn. with fluoxetine in the treatment of Obsessive-Compulsive Disorder. *Prog Neuropsychopharmacol Biol Psychiatry*. 2010;34(2):362-365. doi:10.1016/j.pnpbp.2009.12.016
- ❖ Valerian 765mg/day in adults
 - ❖ Paksereshf S, Boostani H, Sayyah M. Extract of valerian root (Valeriana officinalis L.) vs. placebo in treatment of obsessive-compulsive disorder: a randomized double-blind study. *J Complement Integr Med*. 2011;8(1):jicim.2011.8.issue-1/1553-3840.1465/1553-3840.1465.xml. Published 2011 Oct 11. doi:10.2202/1553-3840.1465



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Evidence-Based Symptom Relief: ANXIETY

- ❖ Clinical evidence: Omega-3 fatty acids, Vitamin D3, Magnesium
- ❖ Omega-3 FAs (975mg EPA + 675mg DHA) + Inositol 2000mg (≥ 25 mg) or 80mg/kg (< 25 kg)
 - ❖ Wozniak J, Farrell A, DiSalvo M, et al. A Randomized, Double-Blind, Controlled Clinical Trial of Omega-3 Fatty Acids and Inositol as Monotherapies and in Combination for the Treatment of Pediatric Bipolar Spectrum Disorder in Children Age 5-12. *Psychopharmacol Bull.* 2022;52(4):31-51.
- ❖ L-Theanine 200mg + Vitamin B6 2.8mg
 - ❖ Rizzo R, Prato A, Scerbo M, Saia F, Barone R, Curatolo P. Use of Nutritional Supplements Based on L-Theanine and Vitamin B6 in Children with Tourette Syndrome, with Anxiety Disorders: A Pilot Study. *Nutrients.* 2022;14(4):852. Published 2022 Feb 18. doi:10.3390/nu14040852
- ❖ Ashwagandha 250mg-1000mg ÷ BID in adults
 - ❖ Speers AB, Cabey KA, Soumyanath A, Wright KM. Effects of *Withania somnifera* (Ashwagandha) on Stress and the Stress- Related Neuropsychiatric Disorders Anxiety, Depression, and Insomnia. *Curr Neuropharmacol.* 2021;19(9):1468-1495. doi:10.2174/1570159X19666210712151556
- ❖ Walking in nature
 - ❖ Grassini S. A Systematic Review and Meta-Analysis of Nature Walk as an Intervention for Anxiety and Depression. *J Clin Med.* 2022;11(6):1731. Published 2022 Mar 21. doi:10.3390/jcm11061731



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OPTIMIZE VAGAL TONE (HRV)



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Did you know ...



Optimizing Vagus Nerve function can improve your gut microbiome independent of diet!



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The 5 Things: Breathe (The Vagus Nerve & Gut Microbiome)

- ❖ HRV is a measure of Vagus Nerve function
 - ❖ HRV ~ Respiratory Sinus Arrhythmia
 - ❖ HRV > 15 bpm is NORMAL
 - ❖ ALL kids should have this or more...
 - ❖ <10 bpm in patients < 40 years or <5 bpm at any age is ABNORMAL
- ❖ Happiness/positive emotions and high Heart Rate Variability (HRV) associated with higher gut microbiome diversity in children
- ❖ High stress and low HRV associated with lower microbiome diversity in children
- ❖ Independent of diet
 - ❖ <https://pubmed.ncbi.nlm.nih.gov/31112792/>
- ❖ Optimal HRV lowers cortisol AND increases WBC ability to fight infections
 - ❖ <https://www.ncbi.nlm.nih.gov/pubmed/9654763>



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QUIZ



What are some (free) ways to improve Heart Rate Variability?



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Optimize vagus nerve function – an **essential** prescription

Optimal HRV = Vagus Nerve Function = Optimal Gut Microbiome

How to optimize HRV

- ❖ Cognitive Behavioral Therapy
- ❖ Mindfulness/Meditation
- ❖ Heartmath
- ❖ Diaphragmatic breathing
- ❖ Gratitude/Loving Kindness
- ❖ Laughter
- ❖ EFT Tapping
- ❖ Acupuncture
- ❖ Vagus Nerve Stimulation



Mindfulness/Meditation can be practiced anywhere, anytime...

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Optimize HRV – Cognitive Behavioral Therapy

CBT is a cornerstone of treatment in PANS/PANDAS
 CBT can increase HRV

- ❖ 43 young women with IBS → 8-week CBT intervention
- ❖ Improvement in GI sx and HRV sustained at 24 weeks
 - ❖ Jang A, Hwang SK, Padhye NS, Meiningner JC. Effects of Cognitive Behavior Therapy on Heart Rate Variability in Young Females with Constipation-predominant Irritable Bowel Syndrome: A Parallel-group Trial. *J Neurogastroenterol Motil.* 2017;23(3):435-445. doi:10.5056/jnm17017

Individual or group CBT
 Dawn Huebner, PhD's kids' "self-help books"



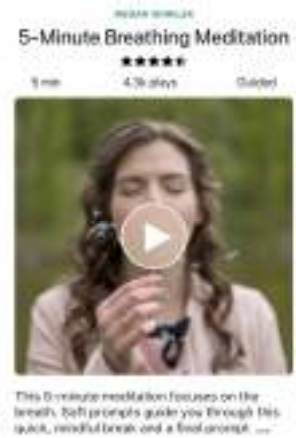
55

Optimize HRV– Mindfulness/Meditation

Mindfulness/meditation apps

- Insight Timer
- Headspace app
- Calm app
- Oak app

Inner Balance Heartmath app



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Optimize HRV– Connection/Gratitude

“Loving kindness” meditation x 6 weeks

- ❖ Increased HRV, greater sense of connectedness to others, increased positive emotions (joy, interest, amusement, serenity, hope)
- ❖ Kok BE, Coffey KA, Cohn MA, et al. How positive emotions build physical health: perceived positive social connections account for the upward spiral between positive emotions and vagal tone [published correction appears in Psychol Sci. 2016 Jun;27(6):931]. Psychol Sci. 2013;24(7):1123-1132. doi:10.1177/0956797612470827



May you feel safe
May you feel happy
May you feel healthy
May you live with ease



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Optimize HRV– Breathe

- ❖ Diaphragmatic “belly breathing” to activate of the vagus nerve
 - ❖ Get out of fight-flight-freeze
 - ❖ Get into rest-digest-heal...
- ❖ Diaphragmatic breathing benefits:
 - ❖ Lower cortisol
 - ❖ Increased HRV
 - ❖ Increased energy, alertness, relaxation, mood
 - ❖ Decreased anxiety, depression, anger, confusion



Zoccar A et al. How Breath-Control Can Change Your Life: A Systematic Review on Psycho-Physiological Correlates of Slow Breathing. [Front Hum Neurosci](https://doi.org/10.3389/fnhum.2018.00353). 2018 Sep 7;12:353. doi: 10.3389/fnhum.2018.00353

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Teach Your Child to “Belly Breathe”

- ❖ Sit or lie comfortably
- ❖ Place one hand on chest
- ❖ Place the other hand on belly
- ❖ Pretend there’s a balloon in their belly that they need to inflate every time you take a deep inhale, and deflate fully with every exhale
- ❖ Breathe in through their nose and fill that balloon, noticing the hand on their belly rise, and the hand on their chest staying still
- ❖ Breathe out through their mouth, feeling the hand on their belly sink all the way down, while the hand on their chest remains still

Sesame Street: Common and Colbie Caillat – “Belly Breathe” with Elmo
<https://www.youtube.com/watch?v=mZbzDOpyIA>



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Optimize HRV– Hum, Sing, Chant

Not just any old song...

- Coherent RSA highest in Mantra singing > Choir/hymn singing > Humming

(A) $\text{♩} = 93$ **Härlig är Jorden** B.S Ingemann 1850, C Bääth-Holmberg 1884
 Music: Trad. Silesian Folk Song 1842

(B) $\text{♩} = 48$ **Just Relax** Björn Vickhoff / Rickard Åström

16 G D G Am E7 Am D¹¹ D⁹ D¹¹ D G D G

Just re - lax with my friends. Just re - lax with my friends.

(A) The hymn *Fairest Lord Jesus* (Swedish *Härlig Är Jorden*). The tempo 93 bpm means that two bars take 5.156 s, which invites singers to a 0.194 Hz respiration rate. Four bars take 10.312 (0.097 respiration rate). **(B)** The mantra. Singers are asked to breathe solely between the phrases, which corresponds to a respiration rate of 0.1 Hz.

Vickhoff B, Malmgren H, Åström R, et al. Music structure determines heart rate variability of singers [published correction appears in Front Psychol. 2013 Sep 05;4:599]. Front Psychol. 2013;4:334. Published 2013 Jul 9. doi:10.3389/fpsyg.2013.00334



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Optimize HRV– Laughter

Laughter yoga improves HRV and mood

- Dolgoff-Kaspar R, Baldwin A, Johnson MS, Edling N, Sethi GK. Effect of laughter yoga on mood and heart rate variability in patients awaiting organ transplantation: a pilot study [published correction appears in Altern Ther Health Med. 2012 Nov-Dec;18(6):79]. Altern Ther Health Med. 2012;18(5):61-66.

Laughter really is good medicine!



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Optimize HRV – Emotional Freedom Technique (“EFT” or “Tapping”)

- ❖ Tapping can increase Salivary IgA levels by 113%!
- ❖ Improves HRV and happiness
- ❖ Reduces cortisol, anxiety, depression, pain, cravings

- Bach D, Groesbeck G, Stapleton P, Sims R, Blickheuser K, Church D. Clinical EFT (Emotional Freedom Techniques) Improves Multiple Physiological Markers of Health. J Evid Based Integr Med. 2019;24:2515690X18823691. doi:10.1177/2515690X18823691



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QUIZ



What essential oils can improve Heart Rate Variability?



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Essential Oils & HRV

- ❖ Essential oils that improve HRV
 - ❖ Lavender
 - ❖ Sandalwood
- ❖ Essential oils with anxiolytic effects
 - ❖ *Lavandula angustifolia*
 - ❖ *Citrus aurantium* (bitter orange)
 - ❖ *Citrus sinensis* (sweet orange)
 - ❖ Bergamot
 - ❖ *Achillea wilhelmsii* (Iran)
 - ❖ *Alpinia zerumbet* (shell ginger)
 - ❖ *Spiranthera odoratissima* (Persia)



- Wu CY, Lee HF, Chang CW, Chiang HC, Tsai YH, Liu HE. The Immediate Effects of Lavender Aromatherapy Massage versus Massage in Work Stress, Burnout, and HRV Parameters: A Randomized Controlled Trial. *Evid Based Complement Alternat Med*. 2020;2020:8830083. Published 2020 Nov 23. doi:10.1155/2020/8830083
- Lin PH, Lin YP, Chen KL, Yang SY, Shih YH, Wang PY. Effect of aromatherapy on autonomic nervous system regulation with treadmill exercise-induced stress among adolescents. *PLoS One*. 2021;16(4):e0249795. Published 2021 Apr 13. doi:10.1371/journal.pone.0249795
- De souze DP et al. A Systematic Review of the Anxiolytic-Like Effects of Essential Oils in Animal Models. *Molecules*. 2015 Oct 14;20(10):18620-60. doi: 10.3390/molecules201018620.
- Malcom BJ and K Tallian. Essential oil of lavender in anxiety disorders: Ready for prime time? *Ment Health Clin*. 2018 Mar 26;7(4):147-155. doi: 10.9740/mhc.2017.07.147.
- Zhang N and L Yao. **Anxiolytic Effect of Essential Oils and Their Constituents: A Review.** *J Agric Food Chem*. 2019 Jun 13. doi: 10.1021/acs.jafc.9b00433.



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Optimize HRV – Acupuncture

- ❖ Acupuncture works similarly to vagus nerve stimulation (VNS)
 - ❖ Vagus nerve plays a critical role in maintaining homeostasis of the innate immune response
- ❖ Acupuncture at ST36 , DU26, GB34 found to decrease LPS-induced pro-inflammatory cytokines TNF- α , IL-1 β and IL-6 via the cholinergic anti-inflammatory pathway (animal studies)
 - ❖ Torres-Rosas et al. Dopamine mediates vagal modulation of the immune system by electroacupuncture. *Nat Med*, 20(3), 291-295.
 - ❖ Song J et al. Electroacupuncture at ST26 attenuates pro-inflammatory cytokine release. *African Journal of Traditional, Complement and Alt Med*, 2014.11(2), 469.
 - ❖ Zhang L et al. Inhibiting effect of electroacupuncture at zusanli on early inflammatory factor levels formed by postoperative abdominal adhesions. *Evid Based Complement Alt Med*, 2014, 950326.



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Optimize HRV – Acupuncture

Auricular acupuncture at Shenmen and Point Zero increases HRV during the post-op period in patients undergoing hemicolectomy for colon cancer

- ❖ Young-Chang PA et al. Auricular Acupuncture at the "Shenmen" and "Point Zero" Points Induced Parasympathetic Activation. [Evid Based Complement Alternat Med](#). 2013; 2013: 945063. Published online 2013 Jun 4. doi: [10.1155/2013/945063](https://doi.org/10.1155/2013/945063)



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Acupuncture & anxiety

- ❖ Meta-analyses find positive and statistically significant benefits of acupuncture for treating anxiety with fewer side effects than conventional tx

❖ Amorim D et al. **Acupuncture and electroacupuncture for anxiety disorders: A systematic review of the clinical research.** *Complement Ther Clin Pract*. 2018 May;31:31-37. doi: 10.1016/j.ctcp.2018.01.008.

❖ Goyata SL et al. **Effects from acupuncture in treating anxiety: integrative review.** *Rev Bras Enferm*. 2016 Jun;69(3):602-9. doi: 10.1590/0034-7167.20166903251.

- ❖ Acupuncture at ST41 reduced LPS-induced anxiety in rats

❖ Yang TY et al. **Effect of acupuncture on Lipopolysaccharide-induced anxiety-like behavioral changes: involvement of serotonin system in dorsal Raphe nucleus.** *BMC Complement Altern Med*. 2017 Dec 11;17(1):528. doi: 10.1186/s12906-017-2039-y.

- ❖ Auricular acupuncture in patients with anxiety disorder found to decrease tension, anxiety, anger/aggression

- ❖ Similar to Progressive Muscle Relaxation (accepted relaxation method)

❖ De Lorent L et al. **Auricular Acupuncture Versus Progressive Muscle Relaxation in Patients with Anxiety Disorders or Major Depressive Disorder: A Prospective Parallel Group Clinical Trial.** *J Acupunct Meridian Stud*. 2016 Aug;9(4):191-9. doi: 10.1016/j.jams.2016.03.008.



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Acupressure for anxiety

Heart 7 ("Shen Men" or "Spirit Gate")

- In depression at pinky side of wrist crease
- Relieves anxiety, insomnia, mania, panic, heart palpitation

Use firm yet gentle pressure

Circular motions, or steady pressure

30-60 seconds

Apply essential oils to acupressure points for added therapeutic benefit!

Heart 7
To Calm the Spirit
and nourish the Heart.



Source: <https://gettherightdiagnosis.com/home-remedies/acupressure-for-anxiety/>

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Optimize HRV– Vagus Nerve Stimulators

- ❖ Transcutaneous Vagus nerve stimulators
 - ❖ One device authorized by Health Canada to treat Long COVID
 - ❖ FDA-cleared VNS devices for pediatric migraines and IBS
- ❖ Wearable vibroacoustic frequency device improves HRV
 - ❖ Reduces ADHD and anxiety symptoms in children
 - ❖ Improves sleep quality, cognitive performance, athletic recovery
 - ❖ Hallihan C, Siegle GJ. Effect of vibroacoustic stimulation on athletes recovering from exercise. *Eur J Appl Physiol.* 2022;122(11):2427-2435. doi:10.1007/s00421-022-05026-x
 - ❖ Rabin D, Siegle G. Toward Emotion Prosthetics: Emotion Regulation Through Wearable Vibroacoustic Stimulation. *Bio Psych.* 2018; 83(9): S380-S381. doi: <https://doi.org/10.1016/j.biopsycho.2018.02.978>



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The Gut ReSET



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The Gut ReSET plan

Return to the 5 Things for Microbiome Magic

Seal and heal the leaky gut

- ❖ Give your gut a break
- ❖ Gut Repair Nutrients (zinc, glutamine, omega-3 fatty acids, quercetin, digestive enzymes)

Eliminate dysbiotic gut microbiomes (if present)

- ❖ Feed the good guys first
- ❖ Use Food as Medicine (see Tiny Health's Spice Chart)
- ❖ Use herbal and/or prescription antimicrobials as indicated
- ❖ LPS (endotoxin) binder (Serum-derived Bovine Immunoglobulin) if needed


Transform the gut microbiome

- ❖ Targeted Pre-, Pro-, Postbiotic supplementation
 - ❖ Evidence-based strain-specific probiotic supplementation when possible
 - ❖ Increased Vagus Nerve support (Tapping, Acupuncture, Heartmath, Apollo Neuro, TruVaga)




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THE WHEEL OF
Whole Gut Resilience



The Gut ReSET


Return to the "5 Things" for Microbiome Magic

Seal and heal the leaky gut

Eliminate pathogenic microorganisms (if present)

Transform the gut microbiome

The most important foundation for getting well and staying well



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How do we know if the
gut microbiome is already disrupted?

UNDERSTAND WHAT A HEALTHY PEDIATRIC
GUT MICROBIOME IS FIRST



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Children's & teens' gut microbiomes
ARE NOT LITTLE ADULT MICROBIOMES ...



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Healthy gut microbiome in adults vs. infants

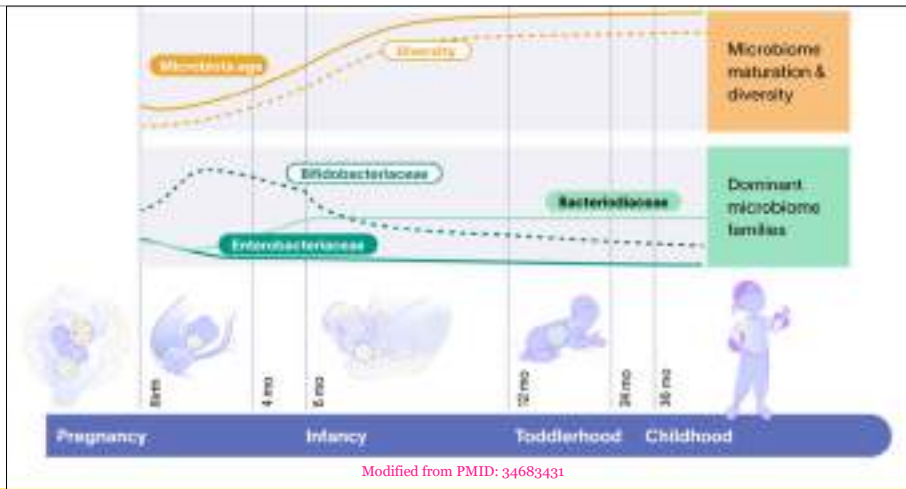
	Adults	Infants
Diversity	High	Low (increases as foods are introduced)
Opportunistic/ Pathogenic Microbes	None to Low	Moderate to Low (helps train the immune system)
Mucosal Barrier & Junctions	Tight Junctions	Highly Permeable (theoretically until 22 weeks)
Short Chain Fatty Acids	Butyrate	Acetate (bifidobacterium)



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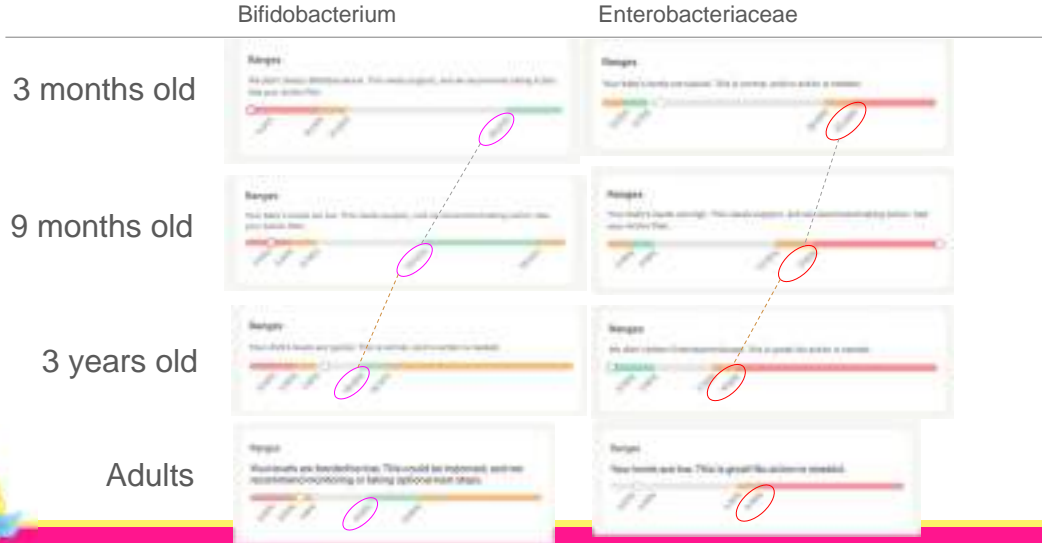
“Healthy” reference ranges change rapidly in the first 1,000 days



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“Healthy” reference ranges change rapidly in the first 1,000 days



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Targeted gut microbiome recovery

GUIDED BY AGE-APPROPRIATE MICROBIOME ANALYSIS




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New international consensus microbiome testing in clinical practice

Microbiome tests are becoming popular among the lay public and health professionals to diagnose and manage microbiome-related conditions. A new consensus involving scientists in basic and translational science updates the ins and outs of microbiome testing in clinical practice.



The Lancet Gastroenterology and Hepatology
Volume 10, Issue 2, February 2025, Pages 154-164

Review
International consensus statement on microbiome testing in clinical practice

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Third, gut microbiome profiling should use amplicon (e.g., 16S rRNA) or whole-genome sequencing. While conventional microbial cultures or polymerase chain reactions may help identify specific pathogens, they are not recommended for microbiome analysis and cannot be used as a proxy for microbiome testing. When profiling the microbial community, microbiome tests should incorporate ecological measures (i.e., alpha and beta diversity measures) and complete taxonomic profiling, compared with a matched control group.

Fourth, the report of the microbiome test should include the patient's medical history and the test protocol, including stool collection, DNA extraction, and post-sequencing analyses. Taxa and clusters relevant to human health must be consistently reported alongside alpha and beta diversity measures with the deepest possible taxonomic resolution. At the same time, particular dysbiosis indices (e.g., Firmicutes/Bacteroidetes ratio) and composition at the phylum level should be excluded in microbiome testing reports as they do not capture the variation in the gut microbiome within the same host and between hosts and there is insufficient evidence to establish a causal relationship between specific dysbiosis indices and host health.

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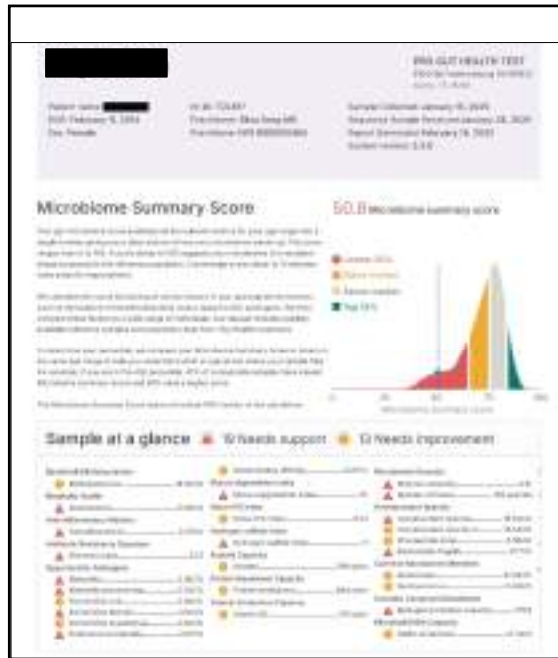
How do you restore a disrupted gut microbiome?

IT'S NEVER TOO LATE TO RESTORE A DISRUPTED GUT MICROBIOME!



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E.B. – 10 y/o girl with ADHD, anxiety, depression & ODD

10 y/o with PTSD, ADHD, dyslexia, anxiety, depression, OCD, ODD

Has tried Prozac, Ritalin, Strattera

Rageful and depressed

Meds have made her worse

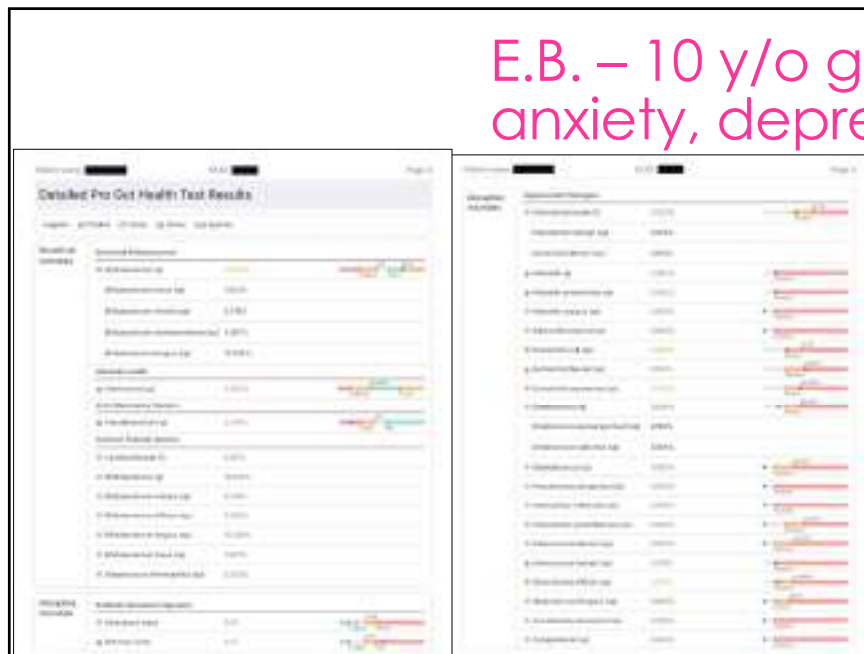
Pt is miserable, family is miserable

Very limited diet and poor appetite, now seeing Endocrine for FTT and short stature



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E.B. – 10 y/o girl with ADHD, anxiety, depression & ODD

Gut dysbiosis

- ❖ Too little Akkermansia and Faecalibacterium
- ❖ Too many gram-negative Klebsiella and E. coli


PLAN:

- ❖ Microbiome-nourishing diet and lifestyle
- ❖ Herbal vs. prescription antibacterial
- ❖ Probiotic supplementation
- ❖ Polyphenol-rich prebiotic supplementation with kiwi and pomegranate extract



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E.B. – 10 Y/O GIRL WITH ADHD, ANXIETY, DEPRESSION & ODD

Leaky gut


- ❖ High mucus degradation index
- ❖ High hydrogen sulfide index

Endotoxemia

- ❖ High Hexa-LPS index

PLAN:

- ❖ Gut repair nutrients (glutamine, zinc, omega-3 fatty acids, quercetin)
- ❖ Serum-derived bovine immunoglobulin



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E.B. – 10 y/o girl with ADHD, anxiety, depression & ODD

Low GABA production

PLAN:

- ❖ Supplement with GABA-producing probiotic, L-theanine, Saffron, Holy basil, Magnolia bark



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E.B. – 10 y/o girl with ADHD, anxiety, depression & ODD

Category	Test Name	Result
Inflammatory Bowel Disease	Stool C-reactive protein	None
	Stool Lactoferrin	None
	Stool Calprotectin	None
Celiac Disease	Tissue Transglutaminase IgA	Negative
	Deamidated Gliadin Peptide IgG	Negative
	Deamidated Gliadin Peptide IgA	Negative
Lactose Intolerance	Lactase Activity	Normal
	Lactulose Breath Hydrogen	Normal
	Lactulose Breath Methane	Normal

No evidence of inflammatory bowel disease or malabsorption



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First followup – 1 week phone call

- Slowly improving
- Not as rageful
- Smiling more
- Willing to expand diet and quantity eaten
- Pt and family are finally feeling hopeful ...



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The power of precision microbiome medicine

After just 1 month on the **Gut ReSET:**

Thanks again for everything - we've really noticed a massive change in our daughter ... It is so wonderful to see and to have our daughter back!!! I do think she physically feels better, which is so wonderful. We're so grateful to have your amazing care!



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Repeat microbiome testing in 2 months



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E.B. – 10 y/o girl with ADHD, anxiety, depression & ODD

Gut Information Markers

Mucosal Degradation Index	0.00
Mucosa Degradation Index	0.00
Gluten LPS Index	0.00
Food LPS Index	0.00
Hydrogen Sulfide Index	0.00
Hydrogen Sulfide Index	0.00
Gluten DNA	0.00
Food DNA	0.00

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E.B. – 10 y/o girl with ADHD, anxiety, depression & ODD

Continued Low GABA production

PLAN:

- Supplement with PharmaGABA

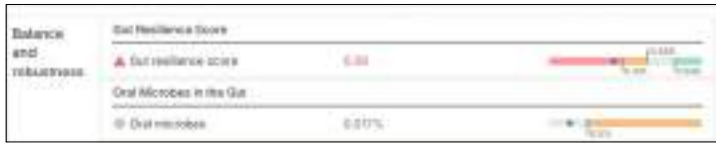
Neurotransmitter & Metabolic Markers

GABA production	0.00
GABA Inactivation	0.00
Unopposed Nitric Oxide	0.00
Secondary Nitric Oxide	0.00
Mitochondrial Health Support	0.00
Unlithium-producing species high	0.00

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E.B. – 10 y/o girl with ADHD, anxiety, depression & ODD



Microbiome Resilience for the win!



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3 months later:

We're so grateful to have found you. Everything we've tried has helped - without the awful side effects like the medications we've tried. it's so great to see my daughter thriving again.



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Everyone can be a Gut Hero!



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Stay in touch!

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